# ASTRONOMY AND ASTROPHYSICS

A European Journal

Volume 13 1971

Published by Springer-Verlag Berlin · Heidelberg · New York
on behalf of the Board of Directors

# Astronomy and Astrophysics

## A European Journal


### Board of Directors

Chairman: A. Blaauw (ESO) — Vice Chairman: G. Strömgren (Denmark)
Secretary and Treasurer: Y. Mazières (France)

L. Biermann (Germany)
H. G. van Bueren (The Netherlands)
J. Delhaye (France)
H. Elsässer (Germany)
Ch. Fehrenbach (France)
W. Fricke (Germany)
G. W. Funke (Sweden)
J. H. Oort (The Netherlands)
E. Schatzman (France)
U. Steinlin (Switzerland)
A. Unsöld (Germany)
A. G. Velghe (Belgium)

### Editors-in-Chief 1969-72

S. R. Pottasch
Kapteyn Astronomical Laboratory
Hoogbouw W. S. N.
University Complex "Paddepoel"
P.O. Box 800
Groningen (The Netherlands)

J. L. Steinberg
Observatoire de Meudon
92 Meudon (France)

### Editing Secretaries

Mrs. M. Steinberg
Miss O. Hänni

Mrs. C. E. Kremer

### Board of Editors

G. B. van Albada (Amsterdam)
W. Becker (Basel)
E. J. Blum (Meudon)
K. H. Böhm (Seattle)
J. Borgman (Roden)
E. M. Burbidge (La Jolla)
G. M. Clemence (New Haven)
Ph. Delache (Nice)
P. Felenbok (Meudon)
V. L. Ginzburg (Moscow)
M. Hénon (Nice)
G. H. Herbig (Lick Obs.)
L. Houziaux (Mons)
J. T. Jefferies (Honolulu)
F. D. Kahn (Manchester)
K. O. Kiepenheuer (Freiburg)
R. Kippenhahn (Göttingen)
J. Kovalevsky (Paris)
H. van der Laan (Leiden)
P. Ledoux (Liège)
J. Lequeux (Meudon)
J. L. Leroy (Pic-du-Midi)
P. O. Lindblad (Stockholm)
B. Morando (Paris)
B. E. J. Pagel (Hailsham)
L. Plaut (Groningen)
F. Praderie (Meudon)
S. I. Rasool (New York)
A. Reiz (Copenhagen)
M. S. Roberts (Greenbank)
M. Ryle (Cambridge)
M. Schmidt (Pasadena)
F. G. Smith (Jodrell Bank)
F. Spite (Meudon)
A. B. Underhill (Goddard Space Flight Center)
H. Van Regemorter (Meudon)
J. P. Wild (Sydney)
L. Woltjer (New York)
J. P. Zahn (Nice)
C. Zwaan (Utrecht)



The exclusive copyright © for all languages and countries, including the right for photomechanical and other reproduction, is vested in European Southern Observatory (ESO)

The quotation of registered names, trademarks, etc. in this journal does *not* imply, even in the absence of a specific statement, that such names are exempt from laws and regulations protecting trademarks, etc. and therefore free for general use.



Springer-Verlag · Berlin · Heidelberg · New York

Printed in Germany

by Brühlsche Universitätsdruckerei, Gießen

# Volume 13 1971

## Contents


**Stars and Stellar Evolution**

Bahcall, J.N., Bahcall, N.A., Kozlovsky, B.Z.: The Ionization Structure of a Nebula Photoionized by a Flat Spectrum 1

Moffat, A.F.J.: Photometry and Structure of the Young Open Cluster NGC 7380 30

Havnes, O.: Magnetic Stars as Generators of Cosmic Rays 52

Lauterborn, D., Refsdal, S., Roth, M.L.: Stars with Central Helium Burning and the Occurrence of Loops in the H-R Diagram. II. Secular Instabilities During the Loops 119

Renson, P.: Space Distribution and Ages of Ap and Am Stars 130

Vilhu, O., Tuominen, I.V.: The Effect of Uniform Stellar Rotation on Absorption Line Strengths and Abundances 136

Vidal, N.V., Shaviv, G., Kozlovsky, B.Z.: Nucleosynthesis during $He^4$ Burning 147

Larson, R.B., Starrfield, S.: On the Formation of Massive Stars and the Upper Limit of Stellar Masses 190

Walter, K.: The Algol System SW Cygni and the Problem of its Asymmetric Primary Minimum 249

Watson, W.D.: Particle Diffusion in Stars Having Shallow Convective Envelopes 263

Gurzadyan, G.A.: On the X-Ray Emission of Flare Stars 348

Hardorp, J., Scholz, M.: The Effect of Rapid Rotation on Radiation from Stars 353

Refsdal, S., Weigert, A.: On the Production of White Dwarfs in Binary Systems of Small Mass 367

Fehrenbach, Ch.: Star S 22 of the Large Magellanic Cloud Showing Emission Lines of Fe II and [Fe II] 437

Maeder, A.: An Observational Evidence of Non-LTE Effects for O-Type Stars 444

Chériguene, M.F.: New Wavelengths' Table for the Determination of Radial Velocities of Late Type Stars 447

**Galactic Structure, Stellar Dynamics, Interstellar Matter**

Rohlfs, K.: On the Structure of Interstellar Matter II. A Correlation between Interstellar Gas Absorption and Dust Extinction ? 46

Pacheco, J.A. de Freitas: The Propagation of Cosmic Ray Nuclei 58

Wendker, H.J.: Radio Observations of Selected H II Regions 65

Pottasch, S.R.: Infrared Line Radiation from the Neighbourhood of the Galactic Center 152

Wooden II, W.H.: *RGU* Photographic Photometry of the Galactic Clusters K 4 and Ba 10 218

Bijaoui, A.B.: Electronographic Study of the Globular Cluster M 13. I 226

Bijaoui, A.B.: Electronographic Study of the Globular Cluster M 13. II 232

Spoelstra, T.A.Th.: A Survey of Linear Polarization at 1415 MHz. II. Discussion of Results for the North Polar Spur 237

Thé, P.S., Paradijs, J.A. van: *UBV* Photoelectric Photometry of Early Type Stars in the Direction of the Association Vul OB 1 and Vul OB 4 274

Alcaino, G.: The Globular Cluster NGC 4833 287

Wielen, R.: The Age Distribution and Total Lifetimes of Galactic Clusters 309

Alcaino, G.: The Globular Cluster NGC 6541 399

van der Kruit, P.C.: Attempt to Explain the Motions of the Gas in the Central Region of the Galaxy by Explosive Events in its Nucleus 405

Fünfschilling, H.: Three-Color Photometry of a Field in the Large Sagittarius Cloud 454

Meaburn, J.: The Profiles of the [O III], 5007 Å Line from the Dumb-bell Nebula 478

**Galaxies, Cosmology**


Rogstad, D.H., Shostak, G.S.: Aperture Synthesis Study of Neutral Hydrogen in the Galaxy M 101: I. Observations 99
Rogstad, D.H.: Aperture Synthesis Study of Neutral Hydrogen in the Galaxy M 101: II. Discussion 108
Brosche, P.: Rotation and Type of Galaxies 293
Karlsson, K.G.: Possible Discretization of Quasar Redshifts 333


**The Sun**


Koutchmy, S.: Three Dimensional Model of a Large Coronal Streamer with Active Region Enhancement 79
Stix, M.: A Non-Axisymmetric $\alpha$-Effect Dynamo 203
Frisch, H.: Non-linear Coupling between Thermal Conduction and Radiative Transfer 359
Alazraki, G., Couturier, P.: Solar Wind Acceleration Caused by the Gradient of Alfvén Wave Pressure 380
Scalise jr., E., Basu, D., Marques Dos Santos, P.: Inversion in Sense of Circular Polarization with Respect to Frequency for Solar Microwave Bursts 471


**Physical Processes and Astrophysical Plasmas**


Karstensen, F., Köster, H.: Relative Excitation Functions for Electron Impact with Magnesium 116
Sahal-Bréchot, S., Segre, E.R.A.: Semi-Classical Calculations of Electron and Ion Collisional Broadening of the Strongest U.V. Ionic Lines of Astrophysical Interest 161
Beaudet, G., Tassoul, M.: Fitting Formulae for a Relativistic and/or Degenerate Electron Gas 209
Kegel, W.H.: Nonlinear Thomson Scattering and Nonthermal Radio Emission 280
Bely, F.: Numerical Calculations of Atomic Structure Constants 336
Chanmugam, G., Gabriel, M.: Neutron Star Models and Pulsars 374


**Planetary System**


Hovenier, J.W.: Multiple Scattering of Polarized Light in Planetary Atmospheres 7


**Celestial Mechanics and Astrometry**


Prochazka, P.V.: On the Reality of the Stellar Ring in Aquila 71
Benest, D.: Elliptic Restricted Problem for Sun-Jupiter: Existence of Stable Retrograde Satellites at Large Distance 157
Edelman, C.: Application of Kalman-Bucy Filtering to the Mass Determination of a Celestial Body 198
Fricke, W.: A Rediscussion of Newcomb's Determination of Precession 298
Couteau, P.: A New Double Star Survey. Its Motivation 345
Broucke, R., Lass, H., Ananda, M.: Redundant Variables in Celestial Mechanics 390
Laubscher, Roy E.: The Motion of Mars: 1751–1969 426


**Instruments and Data Processing**


Andersen, J.: The Schmidt Telescope as an Astrometric Instrument 40
Brault, J.W., White, O.R.: The Analysis and Restoration of Astronomical Data via the Fast Fourier Transform 169


**Research Notes**


Navach, C., Lehmann, M.: An Attempt to Derive an Interstellar Extinction Law in the Ultraviolet by Balloon-Borne Observations 323
Bénévidès, P., Débarbat, S., Koppe, E., Postoiev, A.: Observations of Planets made with the A. Danjon Astrolabe at the Sao-Paulo Observatory 326
Grevesse, N., Swings, J.P.: Forbidden Fe I Lines in Sunspots 329
Allison, A.C., Dalgarno, A.: Rotational Excitation of CN by Electron Impact 331
Grossman, A.S., Opoien, J.W.: The Double Valued Nature of the Hydrogen Main Sequence 487
Gahm, G.F., Winnberg, A.: OH Observations at the Positions of T Tauri Stars in the Taurus-Auriga Region 489
Kohoutek, L.: New Planetary Nebulae 493
Pfleiderer, J.: Short-Term Stability of the Crab Pulsar 496

**Errata**

BOTTINELLI, L., CHAMARAUX, P., GÉRARD, E., GOUGUENHEIM, L., HEIDMANN, J., KAZÈS, I., LAUQUÉ, R.: 21-cm Neutral Hydrogen Line and Continuum Study of the Galaxy Maffei 2 497

**Abstracts of Articles which will be Published in A. A. Suppl. 4, No. 1**

SHANE, W. W.: Neutral Hydrogen in an Interior Region of the Galaxy 498

RUFENER, F., MAEDER, A.: Notice Concerning the Determination of the Geneva Observatory Photometric System's Pass-Bands 498

WESTERLUND, B. E.: A Catalogue of Carbon Stars in the Southern Milky Way 498

**Abstract of an Article which will be Published in A. A. Suppl. 4, No. 2**

PLAUT, L.: Variable Stars in a Field Centre II at $l^{II} = 0°$, $b^{II} = -10°$ 498

(Indexed in Current Contents)

# Author-Index


Alazraki, G. 380
Alcaino, G. 287, 399
Allison, A. C. 331
Ananda, M. 390
Andersen, J. 40

Bahcall, J. N. 1
Bahcall, N. A. 1
Basu, D. 471
Beaudet, G. 209
Bely, F. 336
Benest, D. 157
Bénévidès, P. 326
Bijaoui, A. B. 226, 232
Bottinelli, L. 497
Brault, J. W. 169
Brosche, P. 293
Broucke, R. 390

Chamaraux, P. 497
Chanmugam, G. 374
Chériguene, M. F. 447
Couteau, P. 345
Couturier, P. 380

Dalgarno, A. 331
Débarbat, S. 326

Edelman, C. 198

Fehrenbach, Ch. 437
Fricke, W. 298
Frisch, H. 359
Fünfschilling, H. 454

Gabriel, M. 374
Gahm, G. F. 489
Gérard, E. 497
Gouguenheim, L. 497
Grevesse, N. 329
Grossman, A. S. 487
Gurzadyan, G. A. 348

Hardorp, J. 353
Havnes, O. 52
Heidmann, J. 497
Hovenier, J. W. 7

Karlsson, K. G. 333
Karstensen, F. 116
Kazès, I. 497
Kegel, W. H. 280
Köster, H. 116
Kohoutek, L. 493
Koppe, E. 326
Koutchmy, S. 79
Kozlovsky, B.-Z. 1, 147
Kruit, P. C. van der 405

Larson, R. B. 190
Lass, H. 390
Laubscher, R. E. 426
Lauqué, R. 497
Lauterborn, D. 119
Lehmann, M. 323

Maeder, A. 444
Marques Dos Santos, P. 471
Meaburn, J. 478
Moffat, A. F. J. 30

Navach, C. 323

Opoien, J. W. 487

Pacheco, J. A. de Freitas 58
Paradijs, J. A. van 274
Pfleiderer, J. 496
Postoïev, A. 326
Pottasch, S. R. 152
Prochazka, F. V. 71

Refsdal, S. 119, 367
Renson, P. 130
Rogstad, D. H. 99, 108
Rohlfs, K. 46
Roth, M. L. 119

Sahal-Bréchot, S. 161
Scalise, E., Jr. 471
Scholz, M. 353
Segre, E. R. A. 161
Shaviv, G. 147
Shostak, G. S. 99
Spoelstra, T. A. Th. 237
Starrfield, S. 190
Stix, M. 203
Swings, J. P. 329

Tassoul, M. 209
Thé, P. S. 274
Tuominen, I. V. 136

Vidal, N. V. 147
Vilhu, O. 136

Walter, K. 249
Watson, W. D. 263
Weigert, A. 367
Wendker, H. J. 65
White, O. R. 169
Wielen, R. 309
Winnberg, A. 489
Wooden II, W. H. 218